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A new species of *Laoennea* microsnail (Stylommatophora, Diapheridae) from a cave in Laos

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Abstract

The genus *Laoennea* (Streptaxoidea, Diapheridae) was erected by Páll-Gergely, 2020. The type species, *Laoennea carychioides* Páll-Gergely, A. Reischütz & Maassen, 2020 is so far only known from the type locality cave in Laos. Herein, we describe a second species, *Laoennea renouardi* **sp. nov.**, from a nearby cave in the same karst region of Vientiane Province.

Résumé

Le genre *Laoennea* (Streptaxoidea, Diapheridae) fût érigé en 2020 par Páll-Gergely in Páll-Gergely, A. Reischütz, Maassen, Grego & Hunyadi. L'espèce type, *Laoennea carychioides* Páll-Gergely, A. Reischütz & Maassen, 2020, est jusqu'à présent uniquement connue de la grotte qui tient lieu de localité type, au Laos. Ici, nous décrivons une seconde espèce, *Laoennea renouardi* sp. nov., trouvée dans une grotte proche de la précédente, dans le même système karstique de la province de Vientiane.

Keywords

Gastropoda, Indochina, karst, Nam Song River, shell, subterranean diversity, Vientiane Province

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Mots-clés
Gastropoda, Indochine, relief karstique, rivière Nam Song, coquille, diversité souterraine, Province de Vientiane

Introduction

The taxonomy and systematics of the Asian terrestrial snail family Diapheridae Panha & Naggs in Sutcharit et al. 2010 were recently addressed by Inkhavilay et al. (2019) and Páll-Gergely et al. (2020, 2020b). Based upon morphological evidence, the latter authors identified ten terrestrial genera to this family: *Diaphera* Albers, 1850; *Sinoennea* Kobelt, 1904; *Bruggennea* Dance, 1972; *Platylennea* Páll-Gergely, 2020; *Pupennea* Páll-Gergely, 2020; *Rowsonia* Páll-Gergely, 2020; *Parasinoennea* Z.-Y. Chen & Páll-Gergely, 2020; *Platycochlium* Laidlaw, 1950; *Tonkinia* J. Mabille, 1887 and *Laoennea* Páll-Gergely, 2020. So far, *Laoennea* is only known from its type locality cave, Tham Pou Kham in the Nam Song valley of northern Laos, and comprises one species, *Laoennea carychioides* Páll-Gergely, A. Reischütz & Maassen, 2020 (NHMW 113107) (Fig. 1).

Since the recent designation of *Laoennea*, the shell of another congener from Laos was collected by co-author Marina Ferrand, of the French Club Etude et Exploration des Gouffres et Carrières (EEGC), during the Phouhin Namno speleological expedition in Tham Houey Yè (Tham = cave in Kra-Dai language) in March 2019 (EEGC 2019). Although the new find was documented as "Troglomorphe" in the Phouhin Namno expedition report (EEGC 2019: 114–115), it has remained unidentified. Due to the shell's distinct morphological differences from that of *Laoennea carychioides*, we describe the new species here and present speleological data regarding its subterranean ecological context. This shell constitutes the second record of *Laoennea* from Laos. The type locality, Tham Houey Yè, lies 2.7 km west of the city of Vang Vieng in Vientiane Province and is located 3.4 km east of the type locality of *L. carychioides* (Fig 2).

Methods

Sampling, imaging and measurements

The *Laoennea* shell was sampled by hand. Different perspectives of the shell were imaged using a Leica MC190 HD digital camera attached to a Leica M205 C stereo microscope (Leica Microsystems GmbH, Wetzlar, Germany). The multifocal images were processed using Leica in-house software LAS X EDOF version 3.6.0.20104 (Leica Microsystems). Original images of the type material, *Laoennea carychioides* Páll-Gergely, A. Reischütz & Maassen, 2020 (NHMW 113107) were kindly provided by Barna Páll-Gergely. These images are treated as comparative material and figured herein (Fig. 1H, I). All measurements are in millimeters (mm). Shell measurements are expressed as SH (shell height), SW (shell width), PH (peristome height) and PW (peristome width). Shell whorl number was counted (to the closest 0.25 whorl) according to Kerney and Cameron (1979: 13).

Taxon naming and depositories

Taxon name. The description of the new species *Laoennea renouardi* sp. nov. is attributed to the first and last authors, Jochum and Wackenheim. The complete citation of this new species is *Laoennea renouardi* Jochum & Wackenheim, 2020 in Jochum et al. 2020. The holotype is deposited at the Naturhistorisches Museum Bern (NMBE), Bern, Switzerland.

Institutional abbreviations

ABIMES	Association des Barbastelles d'Issy-lès-Moulineaux pour l'Exploration Spéléologique (Issy-lès-Moulineaux, France);
EEGC	Étude et Exploration des Gouffres et Carrières;
NHMW	Naturhistorisches Museum Wien (Vienna, Austria);
NMBE	Naturhistorisches Museum Bern (Bern, Switzerland);
SCEP	Spéléo Club de l'EPITA (Meudon-La-Forêt, France).

Taxonomy and systematics

Phylum: Mollusca
Class: Gastropoda
Superfamily: Streptaxoidea
Family: Diapheridae

Genus *Laoennea* Páll-Gergely in Páll-Gergely, A. Reischütz, Maassen, Grego & Hunyadi, 2020
Fig. 1K, L

Type species. *Laoennea carychioides* Páll-Gergely in Páll-Gergely, Reischütz, Maassen, Grego & Hunyadi, 2020 by original designation: 2–3 (NHMW 113107).

***Laoennea renouardi* Jochum & Wackenheim, sp. nov.**
http://zoobank.org/D8AD4681-CD11-441D-AEB9-415692F3F94B
Fig. 1A–J

Type locality. Laos, Vientiane Province, Tham Houey Yè, 2.7 km W of Vang Vieng, 245 m a.s.l., 18°56'11"N, 102°25'28"E, collected 150 m from cave entrance in a horizontal gallery usually flooded during the rainy season (18°56'15"N, 102°25'25"E) (Fig. 3), 9 March 2019, M. Ferrand leg.

Type material. ***Holotype*:** 1 shell, SH: 1.80 mm, SW: 1.00 mm, PH: 0.54 mm, PW: 0.54 mm; Fig. 1A–J (NMBE 565863).

Diagnosis. Shell tiny, compact and less elongate than the type species, *Laoennea carychioides*, conical-ovate with fewer whorls. Penultimate whorl inflated above the

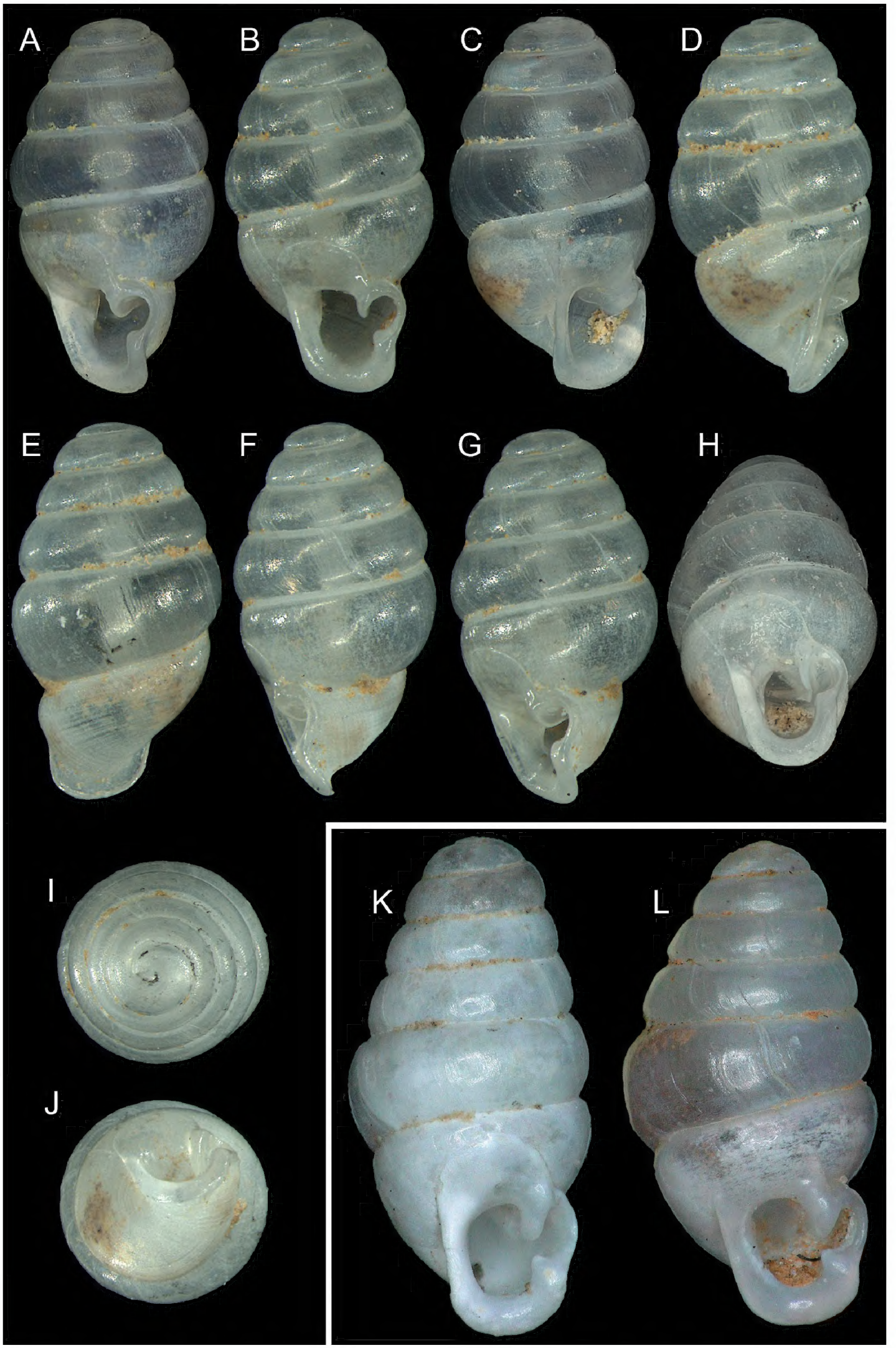

Figure 1. Comparison between species. *Laoennea renouardi* sp. nov. **A–J** holotype (NMBE 565863) **K, L** holotype and paratype shells of *Laoennea carychioides* Páll-Gergely, A. Reischütz & Maassen, 2020 (NHMW 113107). Scale bar: 1 mm.

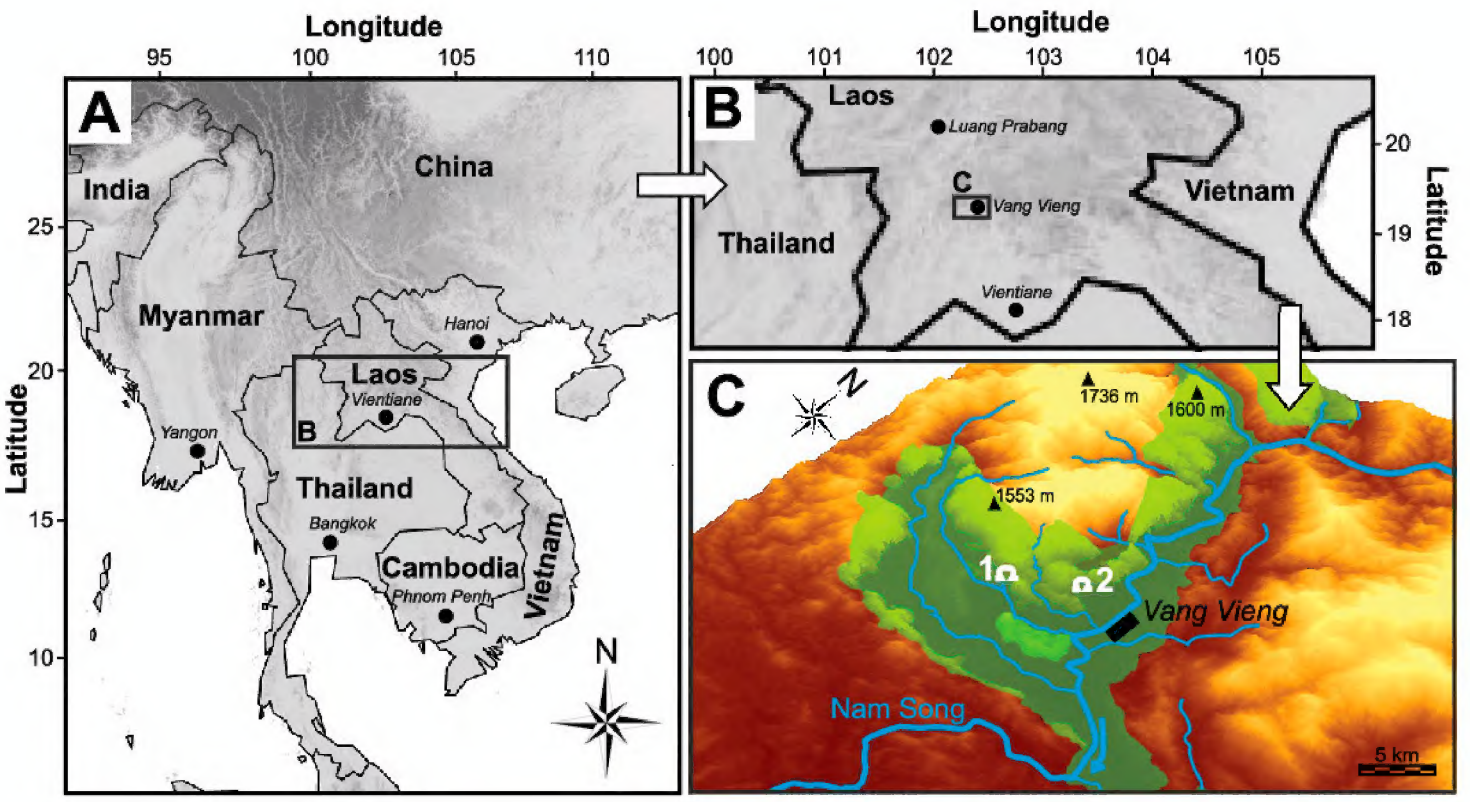

Figure 2. Location and topography of type locality **A, B** maps showing Laos, the geographical origin of the type localities of *Laoennea* species, *L. renouardi* sp. nov. and *L. carychioides*. The greyscale indicates the local mean elevation. This map was downloaded from WORLDCLIM (Hijmans et al. 2005) and political borders were retrieved from Esri Data and Maps (2002) **C** topographical map indicating geological formations and the type locality caves, 1 Tham Pou Kham (*L. carychioides*) and 2 Tham Houey Yè (*L. renouardi* sp. nov.) in two independent karst networks. The map was created using QGIS software 2.18.24. The source of the data for the digital elevation model is SRTM 30 m.

narrower last whorl. Parietal lamella protrudes slightly beyond peristome margin, long, continuing deep into shell. Sinulus in line (on the same plane) with entire peristome and not shifted laterally.

Description. Shell tiny, apical part of the shell dome-shaped, shell white and transparent when fresh, compact with inflated penultimate whorl bulging above the narrower last whorl, shell bears 5 convex whorls separated by a deep suture and a thin white band directly below at the transition of each new whorl; protoconch not clearly discernable. Entire shell glossy, finely pitted, teleoconch streaked by occasional, uneven growth lines. Thin, widely spaced ribs behind peristome extend 1/6 the surface of the last whorl and overlap radial striations of varying thickness embedded within the shell matrix of the last whorl. Aperture heart-shaped, reinforced by thick callus; parietal shield extends to over half the height of the preceding whorl. Apertural dentition three-fold with the parietal lamella and the upper palatal tooth well-formed but not swollen, together forming a round sinulus. Upper columellar side of the aperture shows slight angularity and a low, weak columellar denticle close to peristome. Sinulus opening not shifted laterally but on the same plane as the rest of the aperture. Parietal lamella slender, twisting slightly to the right at the front of the aperture, directed towards the opposing palatal denticle. The parietal lamella forms a smooth ridge which narrows as it continues deep into the shell. Peristome expanded and slightly reflected; umbilicus slit-like, straight columella visible through transparent shell.

Etymology. This species is dedicated to the French speleologist, Louis Renouard, who is a cave and karst specialist of central and northern Laos and who significantly

contributed in the discovery, exploration and mapping of the two caves from which both *Laoennea* species derive.

Distribution. Known only from the type locality, Tham Houey Yè cave.

Ecology. *Laoennea renouardi* sp. nov. was collected 150 m from the cave entrance in a horizontal gallery usually flooded during the rainy season (18°56'15"N, 102°25'25"E). The ambient temperature outside the cave on 9 March 2019 at time of collection was 34 °C. Inside the cave, the temperature measured 26 °C. Tham Houey Yè is located within the Vang Vieng karst region comprising numerous cavities formed in Upper Permian limestone (Dussault 1919; Saurin 1962; Hédouin and Renouard 2000) and harbours 11.2 km of galleries (EEGC et al. 2003; EEGC et al. 2005) (Fig. 3).

Until fresh individuals can be found, it is not yet clear if *Laoennea* is cavernicolous/cave-dwelling or not. The lack of pigment in the transparent fresh shells of *L. renouardi* and the paratype of *L. carychioides* suggests a subterranean ecology. Other taxa encountered March 2019 in Tham Houey Yè during the Phouhin Namno expedition (EEGC 2019) and which are mostly still unidentified include: 1 juvenile cameanid snail, singular members of Rhaphidophoridae, *Zarcosia* sp., Collembola, and different unidentified harvestmen (Arachnida, Opiliones) as well as members of the spider genera, *Sinopoda* and *Heteropoda* (Arachnida, Araneae). The geoecological context of Tham Houey Yè is indicated also in its name: "Houey" means stream or river in the Kra-Dai language of the Lao people and "Yè" is the name of the river.

Conservation. Subterranean snails have a low tolerance to pollution and habitat disturbance. Tham Houey Yè is situated very close to a long-time popular tourist cave, Tham Pha Leusi (18°56'06"N, 102°25'27"E, 250 m a.s.l.) (Fig. 3A). The year after its discovery in 2000, Tham Houey Yè was opened for tourism. Direct tourist activity fortunately ceased a few years later due to the inconvenient necessity of having to crawl into the narrow opening of the cave (Fig. 3D). The proximity of these two caves, and the sharing of the wear and tear impact associated with tourism in addition to potentially polluted allogenic runoff draining into their karst cavities, would very probably threaten *Laoennea renouardi* sp. nov. as well as other subterranean fauna. It is paramount that conscientious regulation of tourism and water management schemes guard against this potential threat.

Discussion

The underexplored vast karst landscapes in Laos and Vietnam, are considered global biodiversity hotspots in SE Asia. These karst landscapes are riddled with caves harbouring a rich endemic cave fauna (Steiner 2013). With the caves of both *Laoennea* species geographically so close, consideration of the geological relationship between Tham Houey Yè and Tham Pou Kham is essential to understanding speciation within this newly erected diapherid genus.

Today, in a straight line, Tham Houey Yè and Tham Pou Kham are 3.4 km apart, are separated by the Yè River and appear to belong to two independent karstic networks

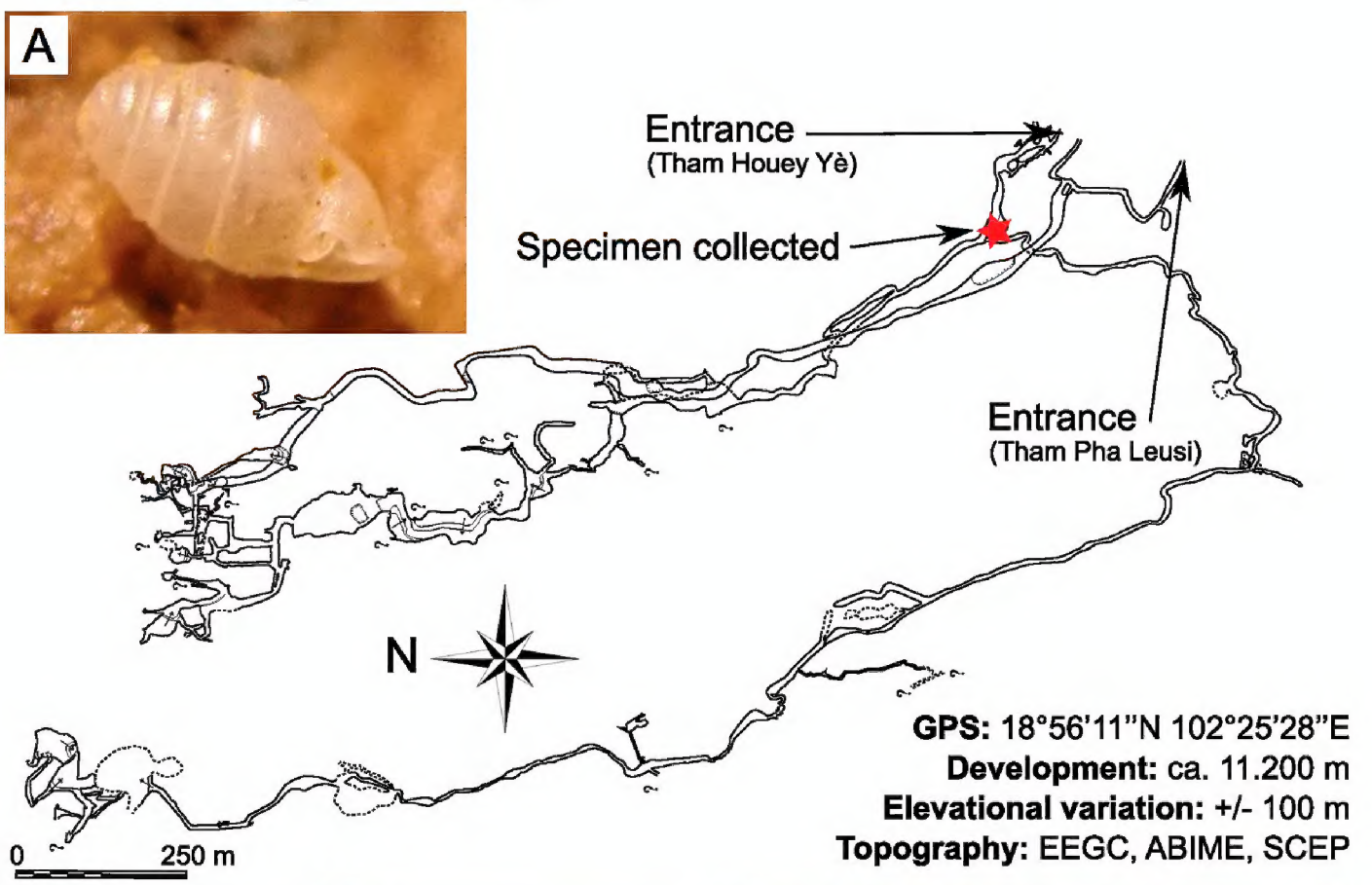

Figure 3. Speleological map and ecology of Tham Houey Yè (18°56'11"N, 102°25'28"E) including 11.2 km of caverns **A** shell of *L. renouardi* sp. nov. on moist substrate (image: M. Ferrand) and map of the cave showing the entrance to the cave, the collection site of *L. renouardi* sp. nov. marked by a red star and the entrance to the nearby touristic cave of Tham Pha Leusi. Tiny question marks on the map indicate uncertainties regarding the continuation of unexplored tiny galleries (EEGC et al. 2003, 2005) **B** landscape view from the entrance of Tham Houey Yè (image: M. Ferrand) **C** west gallery (image: M. Ferrand) **D** natural upper entrance of the cavern system Tham Houey Yè – Tham Pha Leusi (image: M. Ferrand) **E** active section of Yè River during the dry season in Tham Houey Yè (image: J- F. Fabriol).

(Fig. 3C). However, considering surrounding cave altitudes and regional geological history, different phases of karstification (depending on eustatic variations during the Quaternary) can be proposed. One hypothesis supported by the speleologist and specialist of Laotian karst, L. Renouard (pers. comm. 2020), is that Tham Houey Yè and Tham Pou Kham could have been connected during the Quaternary around 100–200 kya. After this time, the river could have additionally formed a vicariant barrier causing formerly contiguous cave systems to become disconnected while allowing populations to become separated and thus, driving the evolution of the two different morphotypes.

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